Center Innovation Fund: ARC CIF

NanoSatellite Thermal Overload Protection System (nSTOPS)

Completed Technology Project (2011 - 2012)

Project Introduction

We propose to develop and demonstrate a laboratory version of a means to electrically dissipate excess thermal energy from 3-cube (and larger) nanosatellites: overheating is a demonstrated issue when such satellites operate in high-sun-exposure orbits. The self-deploying "nanokite" de-orbit mechanism demonstrated on the O/OREOS nanosatellite will be used to support resistive electrical heaters.

The O/OREOS 3-cube nanosatellite is the first nanosatellite to operate above Earth's thermosphere. Its 72° orbital inclination and 650-km orbit result in periods of continuous sun exposure exceeding 12 days, during which payload temperatures often exceed 40° C, above target temperature ranges for astrobiology payloads and above the optimal range for some spacecraft bus subsystems. While the O/OREOS satellite continues to function nominally and features thermally robust biological specimens, many organisms of interest for fundamental biological and astrobiological studies cannot tolerate such heat. As small satellites are increasingly considered for low-cost space experiments beyond LEO, a means to control excessive onboard temperatures must be developed for orbits of high sun exposure. A 3-cube satellite covered on 4 sides by body-mounted solar panels, with radios on one end and a de-orbit mechanism on the other, offers little surface area upon which to locate thermal radiators, which would be ineffective in any case because the satellite's passive magnetic orientation system cannot ensure that they face away from the sun. O/OREOS is the first nanosatellite to utilize a passive de-orbit mechanism, a "nanokite" structure resembling a box kite that deploys from one end of the satellite upon orbital insertion. Adding a few tens of grams and a couple of cm of length to the satellite when stowed, the deployed kite doubles the satellite's overall length, reducing time to atmospheric re-entry from 66 to 23 years. The nanokite offers a unique opportunity for thermal dissipation. The Kapton polymer from which it is fabricated is widely used in printed circuit technology and readily patternable with metal conductors to form resistance heaters. Alternatively, a thermal radiator material could be affixed to the distal end of the nanokite, many cm away from the main spacecraft body, and fitted with power-dissipating resistors.

Anticipated Benefits

Any mission that will have a biological payload or have a temperature-sensitive experiment inside a nanosatellite could greatly benefit from this concept.

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Ames Research Center (ARC)

Responsible Program:

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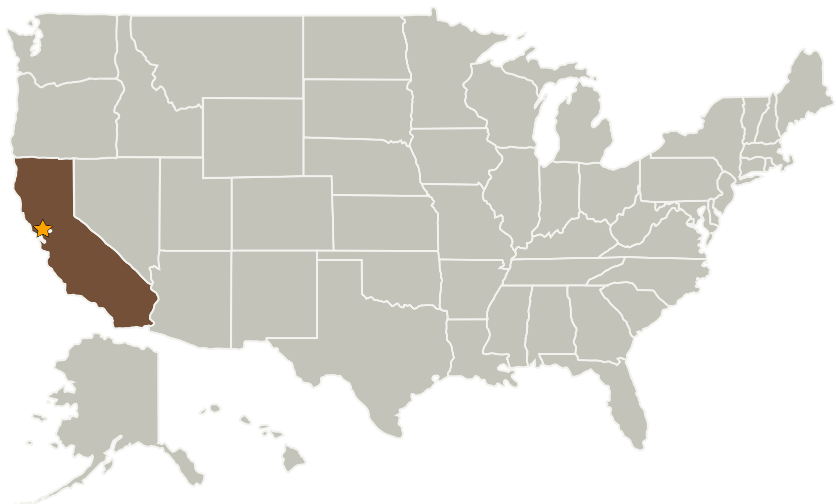
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Ames Research Center(ARC)	Lead Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations
California

Stories

1676 Approval #17536
(https://techport.nasa.gov/file/8735)

Project Management

Program Director:
Michael R Lapointe

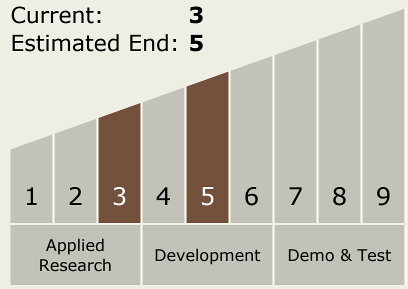
Program Manager:
Harry Partridge

Project Manager:
Antonio J Ricco

Principal Investigator:
Antonio J Ricco

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **5**



Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
  └ TX09.1 Aeroassist and Atmospheric Entry
    └ TX09.1.3 Passive Reentry Systems for SmallSats